the public by persons who never saw the "Flyer" or its flights, of a fictitious story incorrect in almost every detail; and since this story, together with several pretended interviews or statements, which were fakes pure and simple, has been very widely disseminated, we felt impelled to make some corrections. The real facts were as above.

THE THERMOPHONE APPLIED TO GEODESY.

We have several times had occasion to call attention to the convenient and accurate thermophone of Messrs. Henry E. Warren and George C. Whipple, who applied it first to the measurement of the temperature of water in lakes and afterwards to the temperature of the soil. We now also call attention to its application in determining the temperature of a base measuring tape, as used in geodesy. We quote the following from a recent report by John F. Hayford, published as Appendix No. 3 in the Annual Report of the United States Coast and Geodetic Survey for 1901:

Little has yet been published in regard to this apparatus (See Technology, Quarterly, June, 1901, p. 82). It has been developed gradually during the last fourteen years by students of the Massachusetts Institute of Technology, acting under the direction of Prof. A. E. Burton, several theses having been written on different phases of the subject.

The important feature of this form of tape apparatus is the device for obtaining the temperature of the tape. The whole length of the 100-meter tape and an approximately equal length of German-silver wire form two of the arms of a Wheatstone bridge. The two variable arms of the bridge, together with the telephone which is substituted in the place usually occupied by a galvanometer, and the necessary interrupter, batteries, and connections form the thermophone proper. The thermophone has been patented by Messrs. Henry E. Warren and George C. Whipple, and is manufactured by E. S. Ritchie & Sons.[1]

It has been used for determinations of temperature in various ways, and the work of the students at the Massachusetts Institute of Technology now under consideration is mainly that of developing this apparatus to use with long measuring tapes.

The electrical resistance of the steel tape varies more rapidly with a change of temperature than does that of the German silver. The ratio of the resistance of the tape to that of the German silver is, therefore, a measure of their temperatures. Or, with sufficient accuracy, it is a measure of the temperature of the tape, provided the German silver is similarly exposed, so as to have approximately the same temperature as the tape. This ratio is the quantity really measured by the thermophone. The thermophone dial, over which moves a pointer which indicates the position of the contact point regulating the two variable arms of the bridge, is graduated so as to indicate the temperature of the tape in Fahrenheit degrees.

In regard to the Massachusetts Institute tape apparatus as a whole, the writer is convinced: That with the thermophone apparatus in its present form, and using all refinements, measures can be made even in daylight, and when the temperatures are varying rapidly, with a much higher degree of accuracy than is possible with tapes and mercurial thermometers even under good conditions at night.

PERIODS IN SOLAR RADIATION AND TERRESTRIAL TEMPERATURES.

An important communication from Mr. C. G. Abbot of the Astrophysical Observatory, "Recent Studies of the Solar Contant of Radiation," is reprinted in this number of the MONTHLY WEATHER REVIEW.

It is true that the Editor's article in the American Journal of Science, 1870, vol. 750, p. 345, did seem to show that the temperatures observed at Hohenpeissenberg, when treated by a purely statistical method, support the idea that the sun sends us less heat at the time of the sun-spot maximum and that the diminution amounts to about 0.8° R. for 100 units in Wolf's relative sun-spot numbers. For a long time after that publication the Editor believed that it might be possible to establish an intimate connection between solar radiation and solar spots, but the steady development of our knowledge of the selective absorption of the earth's atmosphere has shown that we can not argue by crude statistical methods from terrestrial temperatures up to solar radiation. We may speak of periods and variations in our temperatures, but these do not demonstrate similar periods in the sun's temperature or in its radiations, since unsuspected periodic variations in the earth's atmosphere may be the cause of the variations that we should otherwise attribute to the sun itself.

When we consider the temperature of the earth's atmosphere in and of itself, without asking where the heat comes from, we do find slight traces of irregularities that seem sometimes like regular periods. But these irregularities and periods do not necessarily originate in the sun, even though some of them do show that our low temperatures come at the time of sun-spot maxima. It is quite as likely that they originate in the earth's atmosphere by the combined action of moisture, winds, or currents. It is demonstrably impossible for any period whatever to permanently exist in the earth's atmosphere. We may have forced periods, such as the diurnal and the annual, but there are no natural periods like those of a tuning fork. If a sun-spot period is manifest anywhere, it is either forced and maintained by the sun spots, or else it is a temporary phenomenon that soon dies away. The mere fact that there is a decrease of temperature in the Tropics at sun-spot maximum argues nothing as to a direct relation of cause and effect between the two phenomena. We have on hand a collection of monthly charts of temperature departures for the whole globe for several successive years, which tend to show that the apparent sun-spot periods in the earth's temperature are purely local, terrestrial matters, moving around from one part of the world to the other, just as do our droughts and our rains, our barometric waves, and our cold waves. We have an analogy in the movement of an oceanic earthquake wave over the globe, going sometimes rapidly and sometimes slowly, reflected from a continent, exaggerated in some arm of the ocean, breaking in waves on a shore, but scarcely felt on an island in mid-ocean, and finally dying out by virtue of innumerable interruptions, as all forced waves do unless they happen to be reinforced by a process similar to that of resonance in sound waves.

If in thus speaking of sun-spot periods and lunar periods as matters of minor importance to meteorology we have seemed to dissuade anyone from spending his time in study along those lines, we have done this with a view, not to discouraging research, but to urging that attention be given to more important fields of research. If one is so constituted that he can study nothing but solar and lunar periods, then let him do that, and possibly some benefit to meteorology may result; but to one who has any general ability in research we must urge that he take up what may be called the internal mechanism of our atmosphere, or the movements and phenomena that must occur in a complex atmosphere resting on the variegated surface of the earth under the influence of a constant emanation from the sun. He will find within the atmosphere a series of periodicities due to the diurnal rotation and the annual revolution of the earth; another series due to the dimensions of the globe and the mass of the atmosphere, and still another series due to the variations of land and water, vapor, cloud, and rain or snow. We would have our best men unravel this internal mechanism before studying the less important and rather problematic celestial influences.

SOUTHPORT EXHIBITION OF METEOROLOGICAL APPARATUS.

At the Southport meeting of the British Association, August, 1903, there was, as usual, an exhibition of scientific apparatus which, on the present occasion, referred especially to meteorology and terrestrial magnetism. The catalogue of the exhibition covers 30 pages, and includes, among other things, the following items that will interest the meteorologist on account of their rarety or novelty:

1. Maps of the world, showing the isobars for June 21, September 21, and December 21, 1901, and March 21, 1903.

[1] Mr. Warren writes that it is now manufactured by the Lombard Governor Co., of Boston, of which he is superintendent.—ED.

2. Self-register of the changes of pressures of the gas in the gasometer at Batavia on August 26–28, 1883, showing the disturbance caused by the eruption of Krakatoa.

3. Barograms from Colaba, Bombay, and Aberdeen, Scotland, for the days between August 26 and September 1, 1883, showing the effect of the eruption on the barometer.

4. Copies of photographic records, showing barometric changes at Radcliffe Observatory, Oxford, due to atmospheric waves connected with the Krakatoa eruption.

5. Copies of barograms at the Radcliffe Observatory, Oxford, during the periods of eruptions of Mount Pelée and La Soufrière, May 4–11, 1902.

6. Curves showing the monthly variation of the temperature of the ground at Radcliffe Observatory, Oxford, at different depths, as determined by platinum resistance thermometers, compared with the air temperature in the shade four feet above the surface.

7. *Meteorological thermometer.*—A fine copper wire wound upon a light mica frame is inclosed for protection in a thin brass tube. The wire readily acquires the temperature of the surrounding air, its electrical resistance changing considerably with change of temperature.

8. *The Calendar recorder for continuous registration of temperature.*—The above-mentioned meteorological or resistance thermometer, arranged for taking the air temperature, is included in one arm of a Wheatstone bridge. When the temperature changes, the bridge balance is upset, and this causes the slider to be automatically moved along the slide wire until the balance is restored. When this recorder is applied to the meteorological thermometer, the recorder corresponds to the variations of electrical resistance of the copper wire, the leads between the recorder and the thermometer being so compensated that their variations of temperature are without effect upon the indications.

9. *Sunshine receiver.*—Two flat zigzag windings of fine platinum wire lie side by side within a glass bulb, hermetically sealed, containing dry air. One of these wires is embedded in a thin layer of black enamel, while the other wire is left bright and has no covering except the bulb. When their temperatures are equal, the two wires are of equal electrical resistance, but the effect of direct sunshine is to raise the temperature of the embedded coil above that of the exposed coil, thus giving rise to a difference of resistance, which is registered by the Calendar sunshine recorder. This recorder is similar to the Calendar temperature recorder described above, but the quantity directly recorded is the difference of resistance of two platinum wires. The total sunshine is estimated as a time integral of intensity, by applying a planimeter to the record obtained.

10. *Indicator connected to the earth-temperature thermometer.*—The thermometer, buried at the point whose temperature is to be observed, is similar to the meteorological or resistance thermometer, described above. The platinum wire resistance is included in one arm of a Wheatstone bridge, the remaining resistances being disposed within the body of the indicator, which also contains a sensitive detector galvanometer of suspended coil type. To take a temperature reading, the position of a slider upon a circular slide wire is adjusted by turning an ebonite head at the top of the case until the galvanometer shows that the point of balance has been reached. The temperature is then directly read off on a dial.

11. *Blakesley portable barometer.*—A tube, closed at one end and open at the other, has a uniform bore of about 1.2 millimeters, and contains a thread of quicksilver about 20 cubic meters long. The length of the body of inclosed air is read in two vertical positions. If A is the length in question when the closed end of the tube is uppermost and B when the open end is uppermost, then the required height of the barometer H is given by

$$H = \frac{A+B}{A-B} L,$$

where L is the length of the thread of quicksilver. If L has been measured once for all at 0° C, no temperature correction is required.[1]

12. Diagrams illustrating a paper by Mr. F. W. Harmer on the meteorology of the glacial epoch, originally published in the Quarterly Journal of the Meteorological Society of London.

13. Two glass positives showing the spectrum of lightning. These were secured by Dr. W. J. S. Lockyer on May 31, 1903, 3 a. m., with a Thorpe grating in front of the photographic objective.

14. *Dine's pressure plate.*—This is attached to the head of a vane so as to face the wind. The small holes on the face of the plate all communicate with an air space inside, and since the holes are all of exactly similar construction and size, and are evenly distributed over the whole surface of the plate, the air pressure inside is very approximately the mean of the pressures on the elements of the face of the plate. There is a similar arrangement for the back of the plate, and a similar statement applies to it. The difference of the pressures in the two air spaces multiplied by the area of the plate gives, therefore, the whole force produced by the wind normal to the face.

This difference of pressure is measured and recorded on the chart of an ordinary pressure tube anemometer, and Mr. Baxendell's experiments have shown that if connecting tubes of suitable size be used the errors due to momentum of the moving parts, which vitiate the records of the ordinary pressure plate, are very trifling.

15. *Besson's harrow nephoscope.*—This instrument consists of a long brass rod, mounted in a vertical position in such a manner that it can revolve freely, and bearing at its upper end a horizontal crosspiece provided with a number of vertical spikes. The observer places himself so that the cloud whose direction of motion is to be ascertained appears in the same straight line as the central spike, and then revolves the crosspiece until the cloud appears to move along the line of spikes, while the observer himself remains motionless. The direction in which the crosspiece is pointing is then read off on a graduated circle provided for that purpose. By observing the time taken for the cloud to pass from spike to spike the angular velocity can be determined.[2]

16. *The gravimetric recording hygrometer of Prof. F. T. Trouton.*—The principle on which the action of this instrument depends is that the *weight* of moisture condensed by bodies such as flannel is, within the meteorological range of temperature, approximately a function of the hygrometric state alone. Thus, when the moisture in the air varies, or the temperature changes, the weight absorbed by a piece of flannel also changes; not, however, in proportion to the amount of moisture present, but in proportion to the hygrometric state. This alteration in weight is shown by the movement of the arm of a balance from which the flannel is suspended, and is recorded by means of an inked stylus, on graduated paper, revolving with a clock-driven drum.

17. *The electrical dew-point hygrometer of Prof. F. T. Trouton.*—The moment of deposition of moisture on a hygrometer of the Dines type is announced by the completion of an electric circuit effected by the deposed moisture. Two long parallel wires are affixed to the surface of deposition. These wires form the electrodes of a circuit containing a battery and indicating instrument. While the circuit is dry there is insulation, but on dew forming the current can pass between the wires. The apparatus can be adapted for use with an automatic recording instrument for giving a record of the dew-point at frequent intervals. It is also of use in positions where the moment of deposition of dew can not be observed by the eye.

18. *Sunshine recorder of Mr. A. Lander.*—A novel instrument in which the sensitive paper is stationary, and the pin hole or narrow slit is revolved by means of clockwork. The slit is close to the sensitive surface of the paper. The instrument is made of aluminum, and is small and light. It gives a very sharp and perfect record and is very sensitive.

19. *Anemometer of Mr. A. Lander.*—This instrument records both direction and pressure, the latter by means of a delicately counterpoised rubber bellows, which is raised by the pressure of the wind and lifts a small conical float suspended in glycerine.

20. *Thermograph of Mr. A. Lander.*—Made with a compound strip of extraordinary sensitiveness to temperature, so that it gives a movement of nearly one inch for difference of 10° F. without the magnification by levers.

THE DIFFUSION OF ODORS IN THE ATMOSPHERE.

The Editor has been accustomed to say that one of the direct evidences of the presence of slowly ascending currents of air is to be found by studying the behavior of buzzards, vultures, and other birds that feed on carrion. We see these birds low down in the horizon at the limit of vision, sailing round and round all day long, until finally, sometimes after the lapse of two or three days, they have been able to trace the smell of their food from great altitudes downward to its location on the ground. The distance from which they come, often a hundred miles, and the vertical height from which they have to descend, perhaps 10,000 feet as an extreme case, give us some idea of the gentle slope of these so-called ascending currents, which are twisted and contorted into every imaginable shape by the wind.

[1] Unfortunately, the Editor does not find the name of Blakesley in our index to meteorological literature, and can not refer to the date of the invention of this portable barometer, but it may be worth stating that he himself, quite independently, devised precisely the same method as a method of illustrating the subject to a class of students in 1882. The results obtained by this simple apparatus would be unexceptionable were it not for the effect of the uncertainty of the influence of capillarity in tubes that are only 1 or 2 millimeters in diameter.—*C. A.*

[2] If an ordinary hand rake be set up with the handle vertical, the head bar and the teeth will be horizontal. If the handle turns about its vertical axis, the head bar can be set in such a position that the cloud under observation may appear to travel from one end of the bar to the other. The direction in which the head bar points is then the true azimuth of the motion of the cloud, and its velocity may be determined by counting the number of teeth passed over in one minute. Of course Besson's apparatus applies only to clouds near the zenith. The ordinary nephoscope can be used for clouds within 15° of the horizon. Another form devised by the Editor in 1871, but not yet constructed, would allow of observations down to the horizon itself, if this were ever desired in meteorology.—*C. A.*